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IS 9628 (1980): Three-phase induction motors with type of protection 'n' [ETD 15: Rotating Machinery]

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Indian Standard

SPECIFICATION FOR THREE-PHASE INDUCTION MOTORS WITH TYPE OF PROTECTION 'n'

(Third Reprint NOVEMBER 1998)

UDC 621.313.333.025.3

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5

March 1981

Indian Standard

SPECIFICATION FOR THREE-PHASE INDUCTION MOTORS WITH TYPE OF PROTECTION 'n'

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SPECIFICATION FOR THREE-PHASE INDUCTION MOTORS WITH TYPE OF PROTECTION 'n'

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 October 1980, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The essential constructional features and test requirements of electrical apparatus with type of protection 'n' are covered in IS: 8289-1976*. This standard has been prepared with a view to specifying the additional requirements which are applicable to three-phase induction motors with type of protection 'n'.

0.3 A statistically satisfactory level of safety may be achieved in Division 2 areas as outlined in IS : 5572 (Part I)-1978† by using electrical apparatus with type of protection 'n'. Such apparatus, which is essentially standard industrial apparatus with special attention given to certain features, is suitable for operation in any gas mixed with air which has an ignition temperature higher than that of the temperature class marked on it. The motors using other techniques of protection, such as flameproof enclosure or intrinsic safety or type of protection 'e', may be used in Division 2 areas provided that the limitations imposed by the grouping of such apparatus are observed, but a substantial saving in cost may be achieved by using apparatus with type of protection 'n'.

0.4 This standard is not intended to take the place of various statutes and regulations, applicable to the installation and use of the electrical apparatus in places where there is an explosion hazard; it has been drawn up to provide a common basis for the construction and testing of motors with type of protection 'n'.

0.5 This standard is to be read in conjunction with IS : 325-1978‡, and where the requirements of this standard differ from IS : 325-1978‡, the requirements of this standard shall apply.

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*Specification for electrical equipment with type of protection 'n'.

†Classification of hazardous areas (other than mines) for electrical installations: Part I Areas having gases and vapours (*first revision*).

‡Specification for three-phase induction motors (*fourth revision*).

0.6 Historically, equipment installed in hazardous areas followed the principles adopted by the mining industry and to start with flame-proof equipment was used which ensured that ignition occurring within the enclosure of a motor did not transmit the flame to the atmosphere surrounding the enclosure. However, flame-proof motors were expensive and in the larger ratings, were difficult to manufacture. The developments in the technology and improvement in installation techniques led to the development of type 'e' protection. However, type 'e' protection restricted the temperature-rise of the apparatus 10°C less than the normally permitted temperature-rise for the class of insulation. The subsequent study of constructional features to render the squirrel cage induction motors non-sparking with a maximum surface temperature of 200°C for motor operating normally so as to prevent auto-ignition of the surrounding gases/vapours which may be released under abnormal operating condition in Division 2 areas resulted in the development of type 'n' protection. The type 'n' motor is an improved version of a normal induction motor with the following additional requirements:

a) Non-sparking (vibration proof) terminals;

b) Adequate creepage/clearances;

c) Adequate tightness of rotor bars in the rotor and brazed or welded end rings, to prevent sparking while starting;

d) Adequate clearance between stator and rotor;

e) Adequate clearance between shaft and bearing cap;

f) Suitable axial and radial clearance between the fan and finned portions of the motor;

g) Provision against accidental reduction in clearance between cable lugs at the cable termination;

h) IP54/IP55 enclosure is usually required by virtue of the locations in which these motors would be used;

j) Terminal box to withstand through faults, without shattering; and

k) Restriction of surface temperature rise to 200°C for temperature class T3 (*see* IS : 8239-1976*) during normal operation as well as starting can be very frequent.

---

*Classification of maximum surface temperatures of electrical equipment for use in explosive atmospheres.

0.7 In laying down this specification, the following assumptions have been made:

a) Flammable gases or vapours, if present in the surrounding atmosphere, will enter the enclosure;

b) The apparatus shall be installed and maintained properly and it shall operate always within the ratings (and recognized overloads, if any). The maintenance and use of this type of apparatus is the entire responsibility of the user;

c) The electric circuit with which the apparatus is associated will include such automatic devices as may be necessary to protect the apparatus in case an electrical defect develops in the apparatus; and

d) Every motor shall be connected with a three-phase motor protection switch adjusted to the rated current of the motor.

If the motor protection switch is not approved for use in hazardous atmospheres, it shall be installed in a safe area.

In the case of high voltage network (more than 1 000 V) which is not solidly earthed and which is operating with earth-fault protection, a two-phase current protective device is deemed sufficient.

0.8 In the preparation of this standard, assistance has been derived from BS 5000 : Part 16 : 1972 Specification for Rotating Electrical Machines of Particular Types or For Particular Applications, Part 16 : Type N Electric Motors.

1. SCOPE

1.1 This standard covers the three-phase induction motors with type of protection 'n' for voltages up to and including 11 000 V, suitable for use in Division 2 areas [*see* IS : 5572 (Part I)-1978*].

NOTE — In a Division 2 area, a flammable or explosive substance whether gas, vapour or volatile liquid, although processed or stored is so well under conditions of control that the production (or release) of an explosive or ignitable concentration in sufficient quantity to constitute a hazard is only likely under abnormal conditions.

2. TERMINOLOGY

2.0 For the purpose of this standard the following definitions, in addition to those given in IS : 325-1978†, shall apply.

---

*Classification of hazardous areas (other than mines) for electrical installations: Part 1 Areas having gases and vapours (*first revision*).

†Specification for three-phase induction motors (*fourth revision*).

2.1 Type of Protection 'n' — A type of protection applied to electrical apparatus such that in normal operation, it is not capable of igniting a surrounding explosive atmosphere and a fault capable of causing ignition is not likely to occur.

2.2 Phase Insulated Terminal Box — The protection of phase conductors against electrical failure within the terminal box is by insulation only. All live parts shall be fully insulated.

2.3 Phase Separated Terminal Box — The protection of phase conductors against electrical failure within the terminal box is by insulation and additionally by earthed metal barriers in a single compartment so as to restrict any electrical breakdown to an earth fault.

2.4 Phase Segregated Terminal Box — The protection of phase conductors against electrical failure within the terminal box is by insulation and additionally by earthed metal barriers forming completely isolated individual phase compartments.

3. SITE CONDITIONS

3.1 The site conditions shall be the same as specified in : 325-1978*.

4. TYPES OF ENCLOSURES

4.1 Motors covered by this standard have one of the degree of protection given in Table 1 of IS : 4691-1968†.

NOTE — For terminal box *see* **6.2**.

5. DIMENSIONS

5.1 The recommended dimensions of foot-mounted induction motors, flange mounted induction motors and vertical shaft motors for pumps should be as given in IS : 1231-1974‡, IS : 2223-1971§ and IS : 2254-1965||, respectively.

NOTE — In some cases, output and frame sizes relationship specified in IS: 1231-1974‡, may not be applicable.

---

*Specification for three-phase induction motors (*fourth revision*).

†Degrees of protection provided by enclosures for rotating electrical machinery.

‡Dimensions of three-phase foot-mounted induction motors (*third revision*).

§Dimensions of flange mounted ac induction motors (*first revision*).

||Dimensions of vertical shaft motors for pumps (*revised*).

6. GENERAL REQUIREMENTS AND CONSTRUCTIONAL DETAILS

6.1 Motors covered under this standard shall be provided with classes 'E', 'B' or 'F' insulations. However, for HV motors rated obove 660 V and up to 33 kV (*see* IS : 585-1962*), class 'F' insulation is preferred. The temperature rise for class 'F' motors will be restricted corresponding to the temperature rise limits of class 'B' insulated motors.

The insulation shall be given tropical and fungicidal treatment and would resist the action of corrosive agents or items tending to dissolve insulation present in the atmosphere of refineries, petrochemical and fertilizer plants. The winding shall be suitable for operation under environments having 100 percent relative humidity. The tropicalizing treatment shall be given as stipulated in IS : 3202-1965†.

The windings with its overhang shall be capable of withstanding the forces occurring during starting and restarting after a short interruption of the mains supply.

6.2 Terminal Arrangement

6.2.1 *Motors for Operation at Voltages Up to and Including 660 V*

6.2.1.1 *Terminals* — Where provided, terminals or connectors shall be substantially designed and, with the exception of earth terminals, shall be insulated from the frame. Connections having pinch screws bearing directly on the conductors shall not be used. Studs shall be so fixed as to prevent their turning when nuts are tightened down.

Means shall be provided to prevent slackening of connections due to vibration.

Means shall be provided to prevent accidental reduction of clearance at terminals due, for example, to loose strands or the swinging of uninsulated cable lugs.

Electrical clearances and creepage distances, with the correct terminals in position, shall comply with the requirements for standard industrial machines (*see* Table 1).

---

*Specification for voltages and frequency for ac transmission and distribution systems (*revised*).

†Code of practice for climate proofing of electrical equipment.

TABLE 1 MINIMUM CREEPAGE DISTANCES AND CLEARANCES AS TO THE GRADING OF INSULATING MATERIALS

(*Clauses* 6.2.1.1 and 6.2.2.1)

RATED VOLTAGE FOR THE INSULATION OF THE EQUIPMENT*	MINIMUM CREEPAGE DISTANCE FOR THE GRADES OF INSULATING MATERIALS (*see also* TABLE 3)				CLEARANCE
	a	*b*	*c*	*d*	
(1)	(2)	(3)	(4)	(5)	(6)
V	mm	mm	mm	mm	mm
60	6	6	6	6	6
250	6	8	10	12	6
380	8	10	12	15	6
500	10	12	15	18	8
660	12	16	20	25	10
1 000	20	25	30	36	14
3 000	45	60	75	90	36
6 000	85	110	135	160	60
10 000	125	150	180	240	100

*The rated voltages of the apparatus may exceed the values stated in the table by 10 percent. The working voltage (of the system) may exceed the rated voltage of the apparatus by an additional 6 percent.

6.2.1.2 *Terminal boxes* — Where provided, terminal boxes shall be designed to give a degree of protection not less than IP 54 as classified in IS : 4691-1968*.

Terminal boxes shall not be open to the interior of the motor unless the degree of protection of the machine is at least IP 41 as classified in IS : 4691-1968*.

Heater or other additional connections, where provided, shall be clearly identified and may be brought out to the terminal box. The minimum clearance and creepage distances shall be 6·3 mm and 11·2 mm, respectively.

When the space heater terminals are provided in the main terminal box itself, a suitable insulation barrier shall be provided between heater and main terminals.

---

*Degrees of protection provided by enclosures for rotating electrical machinery.

6.2.1.3 *Cable sealing and dividing boxes* — Where cable sealing and dividing boxes are required, the clearance and creepage distances shall be in accordance with the dimensions given in Table 1, and the boxes shall provide a degree of protection not less than IP 54 as classified in IS : 4691-1968*.

6.2.1.4 *Cable entries* — For all forms of cable connection, it shall be possible to remove the motor without stressing the cable or breaking any seal provided.

6.2.2 *Motors for Operation at Voltages above 660 V*

6.2.2.1 *Terminals* — Where provided, the terminals or connectors shall be of substantial design and, with the exception of earth terminals, shall be insulated from the frame. Connections having pinch screws bearing directly on conductors shall not be used. Studs shall be so fixed as to prevent their turning when nuts are tightened down.

Adequate means shall be provided to prevent slackening of connections due to vibration.

Means shall be provided to prevent accidental reduction of clearance at terminals.

Electrical clearances and creepage distances, with the correct terminations in position, shall comply with the requirements for standard industrial machines (*see* Table 1). These clearances and creepage distances shall apply even where the terminals or connections are fully insulated.

6.2.2.2 *Terminal boxes* — Where provided, terminal boxes, including removable covers, shall provide a degree of protection not less than IP 54 as classified in IS : 4691-1968* and shall be one of the following:

a) Phase insulated,

b) Phase separated, and

c) Phase segregated.

6.2.2.3 *Heaters* — Heaters or other additional connections, where provided, shall have rated voltages not exceeding 660 V and shall be clearly identified and brought out to a separate terminal box. The minimum clearances and creepage distances shall be 6·3 mm and 11·2 mm, respectively.

---

*Degrees of protection provided by enclosures for rotating electrical machinery.

6.2.2.4 *Cable sealing and dividing boxes* — Where cable sealing and dividing boxes are required, they shall be made from steel and they provide a degree of protection not less than IP 54 as classified in IS : 4691-1968*. Clearance and creepage distances shall comply with the values given in Table 2.

TABLE 2 MINIMUM CLEARANCE AND CREEPAGE DISTANCES IN COMPOUND FOR CABLE SEALING DIVIDING BOXES FOR VOLTAGES ABOVE 660 V

RATED VOLTAGE NOT EXCEEDING	CLEARANCE DISTANCES		CREEPAGE DISTANCES	
	Between Phases	Between Phase and Earth	Between Phases	Between Phase and Earth
(1)	(2)	(3)	(4)	(5)
kV	mm	mm	mm	mm
1·1	12·5	12·5	19	19
3·3	19	12·5	37·5	25
6·6	25	19	63	31·5
11·0	37·5	25	90	45

6.2.2.5 *Leads* — The leads from the cable sealing box to the terminals or connectors and from the terminals to the machine windings, shall have a cross-sectional area sufficient to give a current density in copper not greater than 400 A/mm^2 under the maximum fault current conditions.

NOTE — The current density value is based on a fault clearance time not exceeding 0·25s under short circuit conditions.

6.2.3 The insulating base material shall be non-hygroscopic, fire-proof and resistance to tracking (*see* IS : 2824-1975†) and shall be graded in accordance with Table 3.

6.2.4 Appropriate phase markings as specified in IS : 4728-1975‡ shall be provided inside terminal box.

---

*Degrees of protection provided by enclosures for rotating electrical machinery.

†Method for determining comparative tracking index of solid insulating materials under moist conditions (*first revision*).

‡Terminal marking and direction of rotation for rotating electrical machinery (*first revision*).

TABLE 3 GRADING OF PARTS MADE OF INSULATING MATERIALS

(*Clause* 6.2.3)

GRADE	COMPARATIVE TRACKING INDEX	REMARKS
(1)	(2)	(3)
a	—	Applies only to ceramic material. No test of tracking resistance required
b	500	More than 50 drops
c	380	More than 50 drops
d	175	More than 50 drops

6.2.5 A typical arrangement of terminations for motor with type of protection 'n' is given in Fig. 1 and 2.

6.3 Rotor — The rotor shall be either cast or built.

6.3.1 The rotor shall be dynamically balanced. The vibration level shall be within the limits of normal level specified in IS : 4729-1968*.

6.3.2 *Built-Up Squirrel Cage Rotor* — It is essential to eliminate the risk of sparking during starting and running. To this end, particular attention should be paid to the following points:

a) The conductors throughout the length of the rotor core shall be mechanically tight with respect to adjacent stampings;

b) The joints between conductors and short circuiting rings shall be brazed or welded and compatible materials shall be used to enable high quality joints to be made; and

c) The whole rotor construction shall be such as to avoid fracture of conductors, joints or short circuiting rings throughout the life of the motor.

6.3.3 *Cast Rotor Cages* — Cast rotor cages shall be pressure die or centrifugal castings.

6.3.4 *Wound Rotor* — It shall comply with the requirements specified in **6.3.1**, **6.3.2** and **6.3.3**. In addition, the slip rings and brushes shall be enclosed in a flameproof enclosure or pressurized enclosure.

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*Measurement and evaluation of vibration of rotating electrical machines.

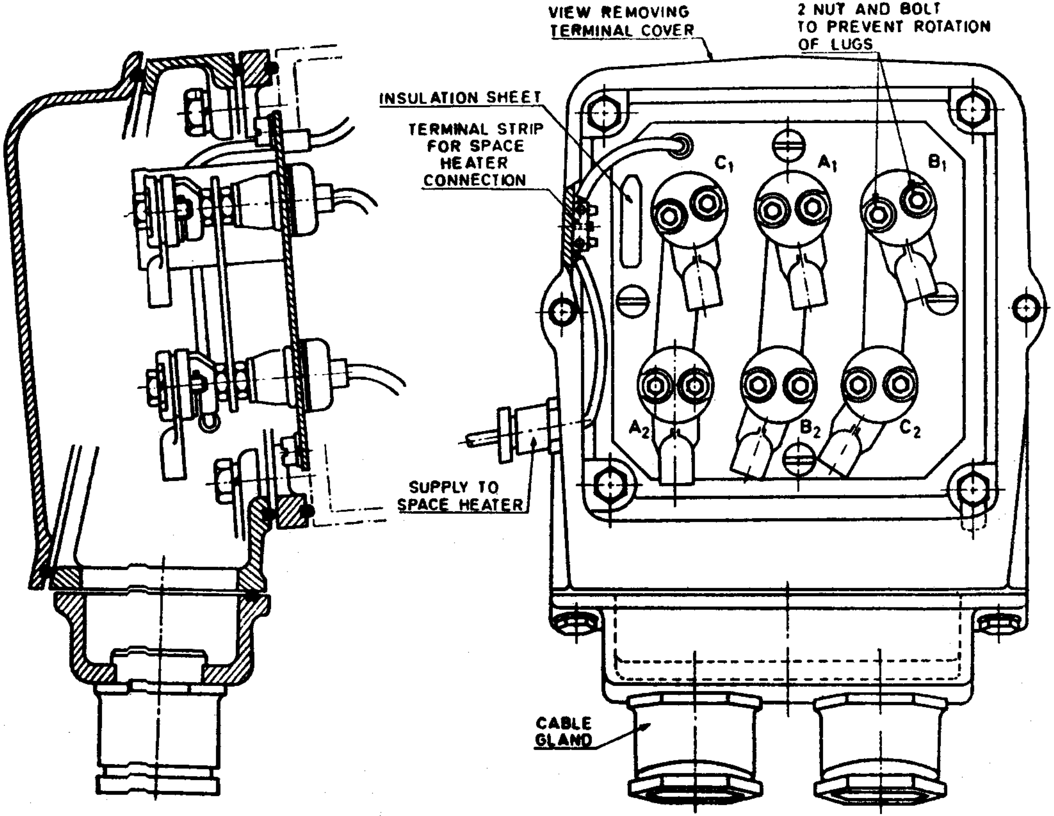
VIEW REMOVING TERMINAL COVER
2 NUT AND BOLT TO PREVENT ROTATION OF LUGS
INSULATION SHEET
TERMINAL STRIP FOR SPACE HEATER CONNECTION
C1
A1
B1
A2
B2
C2
SUPPLY TO SPACE HEATER
CABLE GLAND

FIG. 1 TYPICAL ARRANGEMENT OF TERMINATIONS FOR MOTOR WITH TYPE OF PROTECTION 'n' (First Alternative)

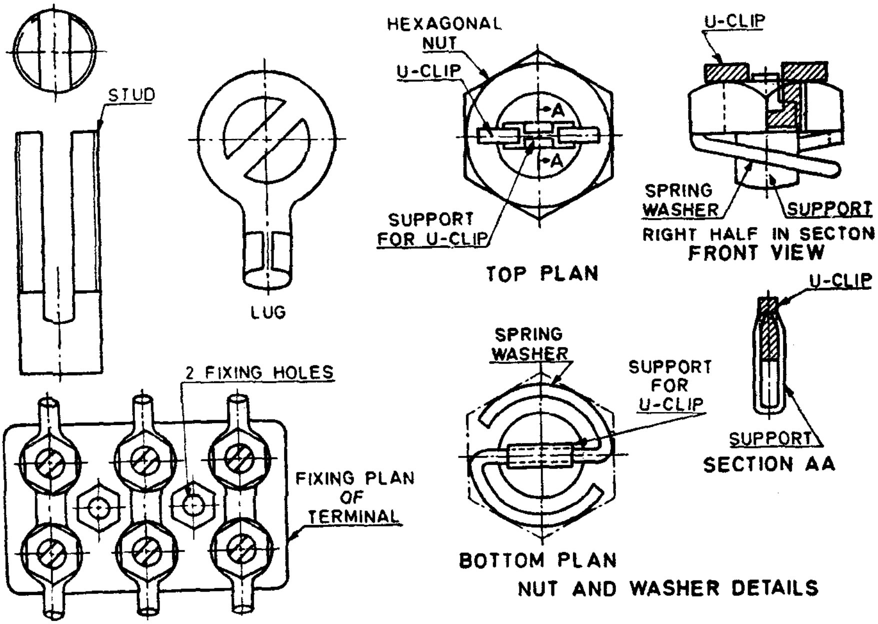

FIG. 2 TYPICAL ARRANGEMENT OF TERMINATIONS FOR MOTOR WITH TYPE OF PROTECTION 'n' (Second Alternative)

6.4 Radial Air Gap

6.4.1 *Nominal Air Gap*

6.4.1.1 The nominal air gap between stator and rotor of motors with rolling element bearings shall not be less than the appropriate value shown in Table 4.

Where the core length L of a motor is more than 1·75 times, the rotor diameter D, the nominal air gap, according to Table 4, shall be multiplied by $\frac{L}{1{\cdot}75D}$.

For motors with plain bearings (sleeve bearing), the nominal air gap according to Table 4 shall be multiplied by 1·5.

6.4.2 *Air Gap* — The air gap when a motor is at rest shall be not less than 90 percent of the nominal value.

Taking into consideration all causes of eccentric positioning of the rotor in the stator bore (bearing clearance, clearances between bearing bracket spigots, deflection of shaft due to rotor weight and loading external to the shaft) and the deflection of the shaft due to the unbalanced magnetic pull resulting from this eccentricity, and after allowing for the permissible reduction of the gap to 90 percent of the calculated value, the final minimum radial air gap for machines with rolling element bearings shall be not less than 0·18 mm, except where the core length L is more than 1·75 times, the rotor diameter D, when it shall be not less than 0·1 $\frac{L}{D}$ mm. In the case of machines with plain bearings, it shall be not less than 0·27 mm.

TABLE 4 MINIMUM NOMINAL RADIAL AIR GAP IN RELATION TO DIAMETER *D* OF ROTOR

(*Clauses* 6.4.1.1 *and* 6.5.3)

NUMBER OF POLES	MINIMUM NOMINAL RADIAL AIR GAP		
	$D \leqslant 75$	$75 < D \leqslant 750$	$D > 750$
(1)	(2)	(3)	(4)
	mm	mm	mm
2	0·25	$0{\cdot}25 + \frac{D\text{-}75}{300}$	2·7
4	0·2	$0{\cdot}2 + \frac{D\text{-}75}{500}$	1·7
6 or more	0·2	$0{\cdot}2 + \frac{D\text{-}75}{800}$	1·2

6.5 Particular Requirements

6.5.1 *Surface Temperature Limitation* — To prevent thermal ignition, the temperature of any external or internal surface to which the explosive atmosphere has access shall under normal operating conditions, excluding starting, not exceed the limiting temperature 200°C. Where a motor is intended to operate under duty cycle conditions, the temperature limit of 200°C shall not be exceeded for the whole of the duty cycle period, including starting if this is part of the duty cycle.

For motors intended for use in areas, where gases or vapours having an ignition temperature below 200°C may occur (*see* Appendix B), in such cases, the manufacturer shall clearly indicate this fact on the rating plate.

NOTE — The manufacturer's calculations or tests may be offered as evidence of compliance with maximum temperature limits.

6.5.2 If an anti-condensation heater is provided it shall conform to the provisions of **6.5.1**.

6.5.3 *Clearance for Fans* — Fans, fan cowls and covers protecting air flow openings, etc, shall be constructed in such a manner, and shall be so arranged and fastened, that no rubbing of rotating parts against stationary parts can occur. The clearances betwen the fan and the stationary parts shall be at least three times, the radial air gap stated in Table 4, or 1 mm, whichever is the greater. These conditions shall apply for all positions of the rotor and when the machine is running.

6.5.4 The clearance between bearing cap and shaft shall not be less than 0·1 mm when the machine is cold.

6.5.5 All fasteners used in the motor shall be protected against corrosion.

6.5.6 All vertical motors with the shaft downwards shall be provided with a canopy for preventing falling particles from getting on the fan cover.

6.5.7 A drain hole with plug screw shall be provided on all totally enclosed fan cooled motors.

7. RATING PLATE

7.1 Rating plate shall be of stainless steel or of a non-corrosive material. It shall be fixed to a non-removable part of the frame and shall furnish all relevant data as listed in IS : 325-1978* in addition to the following particulars:

a) Reference of this standard, that is, Ref ISS..............;

b) Type of protection 'n' ; and

c) Temperature class or maximum temperature.

7.1.1 The product may also be marked with Standard mark.

7.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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*Specification for three-phase induction motors (*fourth revision*).

8. TESTS

8.1 The motors shall be tested in accordance with IS : 325-1968* and IS : 4029-1967†.

9. EARTHING

9.1 The earthing of the motor shall be done in accordance with the relevant provisions of IS : 3043-1966‡.

10. INFORMATION TO BE GIVEN WITH ENQUIRY AND ORDER

10.1 This information to be given with enquiry and order shall be in accordance with Appendix A.

APPENDIX A

(*Clause* 10.1)

INFORMATION TO BE GIVEN WITH ENQUIRY AND ORDER

When enquiring for and ordering motors complying with the requirements of this standard, the following particulars should be supplied in addition to those required by IS : 325-1968*:

a) Reference to this Indian Standard, that is, Ref ISS ....;

b) Maximum fault level of system in mVA (for HV motors rated above 660 V);

c) Type of motor circuit protection (HRC fuses or circuit breaker);

d) Type of cable entry and cable terminations;

e) Maximum surface temperature class for which the motor is required; and

f) Type of corrosive agents likely to be present at site.

---

*Specification for three-phase induction motors (*fourth revision*).

†Guide for testing three-phase induction motors.

‡Code of practice for earthing.

APPENDIX B

(*Clause* 6.5.1)

LIST OF GASES AND VAPOURS KNOWN TO HAVE IGNITION TEMPERATURES BELOW 200°C

The following gases or vapours are known to have ignition temperatures below 200°C:

Ethyl nitrite

Isopropyl nitrate

Carbon disulphide

Acetaldehyde

Diethyl ether

Dipropyl ether

Dibutyl ether

Diamyl ether

Dihexyl ether

Ethyl methyl ether

Diethyl peroxide

Trimethylamine benzaldehyde

There are a few gases and vapours whose ignition temperatures have not been measured, but may be below 200°C. Particular care should be taken with any gas or vapour whose composition is similar to that of any of those listed above. In case of doubt reference may be made to approved testing authorities.

(*Continued from page* 2)

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Shri M. L. Kothari	Indian Jute Mills' Association, Calcutta
Shri D. K. Kulkarni	Jyoti Ltd, Vadodara
Shri P. L. Pradhan (*Alternate*)	
Shri B. Mukhopadhyay	National Test House, Calcutta
Shri A. K. Nagarkatti	Kirloskar Electric Co Ltd, Bangalore
Shri K. G. Betigeri (*Alternate*)	
Shri Dhruv M. Naik	All India Electric Motor Manufacturers' Association, Bombay
Shri M. J. Naik (*Alternate*)	
Shri J. M. Naik	Millowners' Association, Bombay
Shri E. N. Narayanaswamy	Directorate of Industries & Commerce, Madras
Shri C. Natarajan (*Alternate*)	
Shri N. C. Nayak	Hindustan Steel Ltd, Ranchi
Shri A. K. Ghosh (*Alternate*)	
Dr M. S. Padbidri	Hindustan Brown Boveri Ltd, Bombay
Shri Y. D. Dosaj (*Alternate*)	
Dr G. M. Phadke	Indian Electrical Manufacturers' Association Bombay
Shri N. Ramajayam	Indian Machine Tool Manufacturers' Association, Bombay
Shri M. Rangashai	Hindustan Machine Tools Ltd, Bangalore
Miss Nirmala Naik (*Alternate*)	
Shri M. K. Sibbal	Gautam Electric Motors Pvt Ltd, New Delhi
Shri A. N. Srivathsa	NGEF Ltd, Bangalore
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Shri V. P. Gupta (*Alternate* II)	
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Shri S. K. Biswas (Gupta)	Directorate General of Mines Safety, Dhanbad
Shri J. C. Das	The Fertilizer (Planning & Development) India Ltd, Sindri
Shri M. Ganesh	Kirloskar Electric Co Ltd, Bangalore
Shri S. N. Ghosh	Siemens India Ltd, Bombay
Shri V. Ramaswamy (*Alternate*)	

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Members	*Representing*
Shri B. Mukherjee	Mining & Allied Machinery Corporation Ltd, Durgapur
Shri G. K. Girdhar (*Alternate*)	
Shri I. N. Murty	Chief Controller of Explosives, Nagpur
Shri S. K. Bhargava (*Alternate*)	
Shri A. N. Srivathsa	NGEF Ltd, Bangalore
Shri T. Appaswamy (*Alternate*)	
Shri M. B. Tawadey	Central Mine Planning & Design Institute Ltd, Ranchi
Shri A. S. R. Murthy (*Alternate*)	
Shri G. N. Thadani	Engineers India Ltd, New Delhi